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Operating Experience Summary

Office of Nuclear and Facility Safety

April 13 — April 26, 2000

Summary 2000-08

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Operating Experience Summary 2000-08
April 13 through April 26, 2000

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EVENTS

1. GAS-OPERATED GOLF CAR FIRE

On April 6, 2000, at Savannah River, a Bechtel Savannah River Company construction employee attempted to extinguish a fire that consumed a gas-powered golf car utility truck that he was operating. The construction employee was not injured, but the utility truck was a total loss. Contractor management reported this fire because this was the second fire in their fleet of golf car utility trucks in 8 months. An unexplained generic fire risk can expose workers to unnecessary risk of serious injury. (ORPS Report SR--WSRC-CSWE-2000-0009)

Investigators determined that Savannah River Site leases 210 E-Z-GO/Textron Tuff-One golf cars (see Figure 1-1) fitted with truck beds for use as utility vehicles. The 4-wheel utility trucks are based on an E-Z-GO golf car design using as many common parts as possible. They are powered by 11-horsepower Fuji 2-cylinder 4-cycle single overhead cam engines. The engine, battery, starter, alternator, and fuel tank are encased in a sheet metal enclosure mounted beneath a single bench seat. The Tuff-One vehicles are equipped with metal cabs and a fire retardant plywood and foam seat cushion. The engines do not idle. Depressing the accelerator pedal starts the engine and releasing it stops the engine. The throttle plate may not completely close if the accelerator throttle linkage and accelerator micro-switch are improperly adjusted. Maladjustment can allow gasoline to spit back into the paper cartridge air filter and the engine can backfire and ignite a fire.

Figure 1-1. E-Z-GO Tuff-One Utility Truck

Investigators learned that the E-Z-GO Tuff-Ones were leased for three years in June 1996. The lease included a service contract from the manufacturer. This lease was extended for one year in 1999 without renewing the service contract option. Maintenance has been performed in-house by the Portable Equipment Commodity Management Center that managed the leasing since July 1996. In August 1999, a fire in one of these utility trucks occurred. There was minor damage to the vehicle, but no personnel injury.

An industrial forensic expert contracted by E-Z-GO performed an autopsy on the vehicle involved in the August 1999 incident in the presence of DOE and site contractor personnel. The forensic expert concluded that a combination of a dirty air cleaner and an engine backfire were responsible for the fire damage. A DOE engineer earlier had suggested that an electrical fault or short may have been the ignition source for the fire. The green 10 gauge-stranded wire appeared to have fused from the inside out about two inches from the positive battery terminal. E-Z-GO dismissed this theory, claiming that all of the electrical wiring was examined microscopically before the fuel system was examined, and nothing unusual was found. E-Z-GO/Textron will assume the cost of an industrial forensic autopsy for the utility truck that burned on April 6, 2000.

The manufacturer proposed six maintenance action items after the August 1999 fire:

1. Check the accelerator linkage;
2. Check the accelerator micro switch;
3. Check the float level on the carburetor;

4. Check the intake valve adjustment;
5. Check the condition of the air filter element every 20 hours of operation; and
6. Check the fuel filter and carburetor vent.

Enhanced preventive maintenance practices have been implemented for the entire fleet of trucks based upon the manufacturer's recommendations following the August 1999 autopsy. An E-Z-GO/Textron engineer supported Management and Operating contractor mechanics during initial implementation of the in-house maintenance program. Investigators believe that inspections and maintenance by the site contractor have been performed professionally. The maintenance history for the truck that burned on April 6 (see Figures 1-2 and 1-3) shows prior successful repair of a fuel problem. The contractor inspected twenty percent of the trucks since the first fire in August 1999, and found three or four that needed adjustment of the accelerator throttle linkage and accelerator micro switch.

Figure 1-2. Cab View of April 6 Event

Figure 1-3. Passenger Side of April 6 Event

DOE, Westinghouse Savannah River Company (WSRC), and E-Z-GO/Textron representatives held a critique and discussed equipping these vehicles with fire extinguishers. These vehicles do not have any fire suppression system. Investigators determined that the portable extinguisher unsuccessfully used to extinguish the April 6 fire came from a nearby forklift. The extinguisher was discharged ineffectively under a fender because lifting the burning seat was not an option. DOE-SR concurred with WSRC management that placing a portable extinguisher on the vehicles would expose the vehicle operator or any other employee involved to unacceptable risk from erupting flames and fuel. The only effective application of a fire extinguisher would require raising the seat and placing the operator at greater risk. E-Z-GO/Textron proposes installing a small automatic halon fire suppression system, but the cost, environmental risk, and maintenance was considered prohibitive.

Intensive efforts are underway at the site to determine the exact cause of the problem and to implement appropriate corrective actions. The wiring harness routing of an E-Z-GO golf car typical of the two that have burned was examined in detail. The harness sheath showed signs of abrasion where it passed through a horizontal oblong hole punched in the golf car frame directly under the passenger seat. The wiring harness is bound in a woven sleeve of tough nylon to resist casual abrasion. In an experiment with a hole of similar geometry and an unused wire harness for this model golf car, an engineer was able to cut through the nylon sleeve and wire insulation in about 8 seconds

of a sawing motion under pressure, creating direct contact with the conductor inside. The experimenters speculated that after hundreds of hours of rough service in the vehicle this mechanism might result in an electrical fire. Investigators intend to examine the golf car utility truck that burned in August 1999 for evidence of high current and burning at the frame penetration area. If found, this would provide direct evidence of an electrical fire source and a basis for mitigation action for the entire fleet. This area on the golf car cab could be checked for electrical harness wear during routine preventive maintenance and servicing.

Contractor mechanics recently found a paper air filter element in an E-Z-GO golf car with substantial scorching, clear evidence of the backfiring problem described by the manufacturer. During routine maintenance, air filter elements are frequently found contaminated with oil or gasoline a potential fuel source for a fire. Investigators also learned that E-Z-GO completely redesigned the air intake system in their 1997 models, moving the paper element away from the intake by several inches, adding two ninety degree turns, and two expanded metal screens. This considerably reduces the risk of fire from the paper air filter.

KEYWORDS: Golf car, utility truck, maintenance, gasoline fire

FUNCTIONAL AREAS: Maintenance, Fire Safety, Worker Safety

2. EQUIPMENT STORAGE METHODS LEAD TO DAMAGED FIRE SPRINKLER PIPING

On April 7, 2000, at Oak Ridge National Laboratory, facility operations personnel checked a fire sprinkler test assembly and discovered a cracked, leaking water pipe that invalidated the alarm feature's response time. Facility management placed the sprinkler system in a limited condition of operation, initiated a fire watch, repaired the damaged piping, and scheduled a critique meeting. There were no injuries associated with this event. Equipment that is stored improperly can cause damage to facility systems. (ORPS Report ORO--LMES-Y12SITE-2000-0021).

The inspector test valve test assembly establishes a constant water flow rate to simulate sprinkler head activation and trips a fire alarm within a specified time period. Investigators determined that facility operations personnel inspected the assembly and noticed water spraying from a crack near the end of the half-inch carbon steel test piping located three inches from the building's exterior wall. They determined that the pipe damage occurred when workers moved heavy equipment that came into contact with the sprinkler piping. Investigators determined that the equipment was moved in response to a security mandate that required equipment be stored flush with the building to limit criminal access to temporary shelter. Investigators determined that personnel cracked the pipe when they moved a heavy object too close to the building, and that the damage occurred some time ago.

KEYWORDS: cracked pipe, leaking pipe, fire sprinkler

FUNCTIONAL AREAS: industrial safety, materials handling/storage, fire protection

3. EQUIPMENT FIRE DURING D&D OPERATIONS

On April 4, 2000, at Oak Ridge, fire watch personnel attempted unsuccessfully to extinguish a smoldering fire in equipment being decontaminated and decommissioned (D&D). On-scene personnel notified the East Tennessee Technology Park (ETTP) Fire Department who responded and successfully extinguished the fire with portable Class D extinguishers. The fire had progressed beyond what was expected in the work plan. However, the work plan anticipated intervention by the ETTP Fire Department within a few minutes. There were no injuries. Inadequate work planning may result in loss of control during an unanticipated fire occurrence.
(ORPS Report ORO--BNFL-K32-2000-0001)

Investigators determined that D&D personnel were dismantling a piece of K33 legacy equipment for disposal and recycle. The equipment was radiologically contaminated. Investigators determined that the workers had never dismantled such a piece of equipment and incorrectly elected to hot cut the material with a plasma arc. A non-

ignition source for cutting may have been more appropriate, but none was stipulated in the work plan. An invasive smoldering metal fire resulted. Fire watch personnel attempted to extinguish the fire with multiple portable fire extinguishers. One extinguisher, a Class D extinguisher that did not contain Met-L-X agent, assigned in the work plan, was insufficient for the job. A second extinguisher was either a Class BC CO_2 extinguisher or an ABC multiple dry chemical extinguisher, and neither was suitable for handling a metal fire. The CO_2 spray produces water, which can cause the fire to spread. An ABC extinguisher would be ineffective on a Class D metal fire.

Investigators learned that a fire hazard analysis, performed as part of the work plan, incorrectly suggested that a Class BC CO_2 fire extinguisher would be useful for a Class D fire. The fire analysis claimed that a CO_2 extinguisher is appropriate for a metal fire in certain circumstances, but did not emphasize the limitations of using it in this situation. The fire analysis relied on defense in depth. The first strategy involved prevention of an initiating event. [Application of a plasma arc torch was the initiating event.] A second line of defense involved use of appropriate Class D or CO_2 fire extinguishers of adequate size to handle the credible analyzed fire incidents. The third line of defense became the firemen at the ETTP Fire Department who extinguished this metal fire by dispersing the smoldering embers with long handled tools and covering the embers with MET-L-X agent contained in multiple Class D portable extinguishers. The fourth line of defense was a DOE-mandated automatic water deluge fire suppression system, which did not actuate because there was insufficient heat to activate the detectors. Investigators concluded that the fire hazard analysis' last line of defense was that a metal fire might be allowed to burn itself out if it could not be suitably extinguished without undue risk to fire fighting personnel.

EH Engineers have reported similar occurrences involving metal fires in the following Summaries:

- Operating Experience Summary 99-38 reported that on July 26, 1999, at the Lawrence Livermore National Laboratory, a technician noticed that the waste bag he was loading into a metal DOT Type 7A box was glowing and starting to expand. The waste bag contained materials contaminated with depleted uranium. He notified another technician that he had a fire and asked him to call the fire department. The other technician helped him place the lid on the box, and they evacuated the room. The fire department responded and extinguished the fire with Met-L-X agent. Laboratory managers suspended all uranium handling activities while they investigated the cause of the fire. None of the individuals involved, including fire department personnel, were contaminated. (ORPS Report OAK--LLNL-LLNL-1999-0034)

- Operating Experience Summary 99-30 reported that on July 24, 1999, at the Fernald Site, a combustible metal fire occurred while workers were venting 5-gallon metal cans containing thorium metal by puncturing a hole in the lid of the cans. While venting the second can, they saw smoke coming from the puncture hole. Soon thereafter, the fire spread to an adjacent can and to cargo straps and netting restraining the cans to the floor. The workers and their supervisor used three Met-L-X fire extinguishers in an attempt to suppress the fire. They sprayed the extinguishing agent over the cans and attempted to spray it into the puncture holes. The flames outside the cans were extinguished but the contents of the cans continued to smolder. The work crew evacuated the building and summoned emergency response personnel, who placed both cans in a 30-gallon drum and filled the drum with water to cool the reaction. Air samples indicated there was no release of airborne radioactivity, and surveys did not detect the spread of any contamination.
  (ORPS Report OH-FN-FDF-FEMP-1999-0014)

- Operating Experience Summary 98-11 reported that on March 13, 1998, at the Argonne National Laboratory—West Fuels Manufacturing Facility, a technician was consolidating cans of passivated uranium hydride in an air atmosphere glovebox and opened one can, resulting in a spark that caused a fire in both cans. The technician poured MET-L-X powder on the fire to extinguish it, exited the area, and notified fire department personnel. Fire department personnel responded to the event and confirmed that the fire was extinguished. Recovery team personnel verified that containment integrity remained intact and radiological contamination was not spread outside of the glovebox. They also checked ventilation ducts for thermal hot spots and collected, repackaged, and moved the remaining uranium hydride to an inerted glovebox. Investigators determined that 1.5 to 1.7 kg of uranium hydride were involved in this event. They also determined that the technician had successfully consolidated 13 cans before the fire started. Uranium hydride is passivated by exposing it to a dilute oxygen atmosphere to slowly oxidize it to allow safe handling in a normal air atmosphere. The facility manager suspended all work with uranium powder until the cause of this event was determined. DOE assembled an accident investigation team to review this event. (ORPS Report CH-AA-ANLW-FMF-1998-0001)

KEYWORDS: metal fire, MET-L-X agent, Class D fire extinguisher, fire watch, work planning, fire hazard analysis

FUNCTIONAL AREAS: Fire Safety, Decontamination and Decommissioning, Work Planning, Worker Safety

4. SPREADER BEAM FAILS AT LESS THAN RATED CAPACITY

On April 13, 2000, at Savannah River, a seven-ton spreader beam bent at its central point when a crane operator attempted to lift rebar scraps from the ground using two of the four beam lifting points. When the beam failed before it left the ground, the crane operator discontinued the lifting procedure and alerted facility management who placed a moratorium on spreader beam operations and started an investigation. There were no injuries associated with this event and there was no damage to equipment other than the spreader beam. Lifting heavy objects can cause personnel injury and equipment damage when capacities are not accurately calculated and procedures are not properly implemented. (ORPS Report SR--WSRC-CMD-2000-0008).

Investigators determined that the spreader beam is more than twenty years old and that its capacity rating does not meet the requirements in the Savannah River Hoisting and Rigging Manual. They determined that the crane operator used the spreader beam's two innermost lifting points to hoist the rebar load, rather than all four available lifting points. Investigators determined that the rebar scraps were somewhat shorter than the usual length and that the crane operator rigged the spreader beam thinking that the two innermost lifting points would handle the load. Figure 4-1 shows the failed spreader beam.

Figure 4-1. Failed Spreader Beam

This event has prompted facility management to check all site hook-rigging devices dating back to 1990. The site construction rigging authority has discontinued the use of "below-the-hook" rigging devices until they all comply with Savannah River Hoisting and Rigging Manual requirements.

EH engineers identified the following events involving hoisting and rigging.

- Operating Experience Summary 99-31 reported that on July 29, 1999, at Sandia National Laboratory-Albuquerque, a wire-rope sling failed while a contractor was lifting a 15-ft by 25-ft door assembly. The ½-in. wire-rope sling broke into two pieces when the load was within 2 ft of its set-down location. One side of the door assembly was already on the ground, but the other side fell approximately 2 ft, damaging an electrical box and slightly bending some support framing. The sling was rated for 3,200 lb but the load weighed approximately 9,800 lb. No one was injured as a result of the sling failure.
(ORPS Report ALO-KO-SNL-1000-1999-0006)
- Operating Experience Summary 99-17 reported that on April 12, 1999, at the Hanford 222-S Analytical Laboratory, riggers used a jib hoist and an elevated work platform (cherry picker) to lift three sample caves, each weighing more than the rated capacity of the lifting equipment. On April 13, 1999, a chemical technologist noticed that the lift rating of the jib hoist was 2,000 lb. He later noticed that the data plate on one of the sample caves gave the weight of the cave as 2,350 lb. He recognized that the capacities of the lifting equipment had been exceeded on the previous day and informed the building operations manager of the issue. Investigators determined that the lift rating of the cherry picker was also 2,000 lb.
(ORPS Report RL--PHMC-ANALLAB-1999-0011)

KEYWORDS: hoisting, rigging, lifting, spreader beam

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

5. BACK INJURY FROM FALLING PLYWOOD

On April 17, at Lawrence Livermore National Laboratory (LLNL), a worker sustained a fractured vertebra when a sheet of ¾ inch plywood struck him in the upper back and neck. The employee was sent to the LLNL Health Services, then to an outside medical facility for x-rays, and later was released. The employee will not have any permanent injury (paralysis). Careless work planning can lead to a lapse in worker safety and needless injury. Facility management will initiate a type "C" investigation. (ORPS Report OAK--LLNL-LLNL-2000-0021)

Investigators determined that plant engineering laborers were moving a portable clean room, a portable tent approximately 12 feet high, 20 feet wide by 30 feet long covered with heavy plastic sheeting and mounted on a tubular frame with rollers. The work was conducted inside a 1950's era high bay building with a leaky roof.

Investigators learned that rigging workers were relocating the portable tent on wheels to clean and align a piece of equipment. The laborers did not know that other employees had previously placed a 4-foot by 6-foot sheet of plywood and a bucket on top of the portable clean room plastic sheeting to catch water leaking through the building's roof. A piece of chain attached to a fire sprinkler valve caught on the piece of plywood as the portable clean room was being moved. The plywood sheet fell and struck the worker. The worker was treated and released and shortly returned to light duty. There was no work plan, and this type of work is not covered under any written procedure since the portable clean room was on wheels.

EH engineers have reported similar occurrences involving injuries from falling objects:

- Operating Experience Summary 2000-02 reported that on January 13, 2000, at Lawrence Livermore National Laboratory, a construction worker was injured when one end of a 19-ft.-long section of 42-inch intake ventilation duct broke free and swung downward, striking the worker. The duct was being installed on the roof of the National Ignition Facility. The worker was knocked down and complained of back pain. A co-worker called 911, and emergency personnel arrived to assist the injured worker. A temporary walkway was erected to move a stretcher to the area where the injured worker was lying. The worker was airlifted to a local hospital and admitted for possible back injury. (ORPS Report OAK--LLNL-LLNL-2000-0003)

- Operating Experience 99-17 reported that on April 22, 1999, at the Oak Ridge East Tennessee Technology Park, BNFL Inc. senior journeyman sheet metal workers were injured while removing a 2,600-lb section of ventilation ductwork. A forklift truck was supporting the free-hanging, 18-gauge steel duct section when it fell to the floor. The workers had released the duct section from support rods when the load shifted forward and fell off the forklift truck tines. As the ductwork fell, it struck the bucket of a manlift and moved it over several feet, forcibly jostling a worker in the manlift. An 80-lb piece of channel iron under the duct section fell vertically to the floor and tipped over, striking another worker in a different manlift on the front of his hard hat. Both workers were able to exit the work area for treatment by medical personnel. The worker who was in the manlift bucket experienced lower body stiffness in the hip area and the other worker required 10 stitches to close a forehead wound caused by the blow from falling channel iron.
(ORPS Report ORO--BNFL-K33-1999-0004)

- Operating Summary 98-26 reported two events involving personnel injuries that occurred during hoisting and rigging operations. At the Ashtabula, Ohio Decommissioning Project, a subcontractor ironworker received multiple fractures to his leg when he tried to control a swinging bundle of structural steel beams being lifted by a crane. The load struck other structural steel components in the lay-down area, causing two pieces of steel to behave like scissors, pinching the right leg of the ironworker. At Lawrence Livermore National Laboratory a subcontractor steelworker was injured when his head was trapped between a steel truss beam and an outrigger on a crane. He received lacerations to the temple area his head despite his aluminum hard hat.
(ORPS Reports OH-AB-RMI-RMIDP-1998--0003 and SAN--LLNL-LLNL-1998-0034)

KEYWORDS: Injury, falling object

FUNCTIONAL AREAS: Work Planning, Maintenance, Emergency Aid

6. ENERGIZED ELECTRICAL LINES UNEXPECTEDLY DISCOVERED

Three recent events were reported where workers unexpectedly discovered energized electrical lines. On April 14, 2000 at Oak Ridge, a worker using a band saw cut into a conduit containing an energized 480-v line and nicked the wiring. Arcing and sparks occurred and the worker immediately stopped cutting and notified his superintendent, who stopped the work. No one was injured. (ORO--DRS-ETTP1420-2000-0003) On April 13, 2000, at West Valley, workers observed sparks while cutting electrical conduit containing 120V energized conductors during the removal of deactivated equipment. No personnel injury resulted from this event. Finally, on April 11, 2000 at Idaho, shift maintenance electricians were removing light fixtures and believed they saw a spark from a live electrical line. No one was injured. The electricians stopped work and performed additional zero energy checks, finding no other live lines.

In the first event investigators determined that the conduits which were to be cut were marked with pink paint and the worker was one of two who routinely cut conduit. The investigation revealed that the area of the cut conduit is congested with numerous conduits and the worker had mis-identified the conduit section to be cut. The general superintendent stopped work, held a meeting with all electricians and laborers to review the incident and re-review controlling work packages. A safety standown was initiated and corrective actions were commenced.

- A Safety standown was initiated with top level managers in attendance.
- A project management team reviewed work control packages to assess adequacy and any warranty improvements.
- The frequency of paint marks along the conduits will be increased to assist in clearly marking conduits, especially in congested areas.
- Prior to removal, workers will verify adequacy of conduit markings.

In the second event investigators discovered that the workers who were deactivating 120 V electrical equipment believed that the conduit was de-energized based on previous work documents. Subsequent investigation revealed that the current work document did not clearly designate the de-energized portion of the conduit and the location where the conduit was to be cut. A pre-job briefing was conducted; however, the briefing failed to provide clear guidance for execution of the ambiguous work instruction. The operator began cutting the conduit beyond the location where the electrical lines were de-energized. Sparks were observed when the cutting was halfway through

the conduit, and the operator jerked the port-a-band saw back. The saw blade came loose from the saw and remained in the conduit. The operator then removed the saw blade before stopping work. The worker placed himself in additional risk when he attempted to remove the band saw blade still in contact with the energized conductors. Workers who encounter unexpected hazards should immediately stop and remove themselves from the hazard before taking any further actions that may increase the risk to themselves or others.

In the third event investigators determined that the electricians were working with an approved lock-out/tag-out (LO/TO) and did not expect to find any energized circuits. Investigators determined that electricians performed a zero energy check but did not find the additional power source. Prompt attention by the electricians to stop work and perform additional energy checks prevented any further risks of encountering live lines in their work. Stopping work and checking for additional electrical hazards was the correct procedure in this instance.

EH Engineers have reported similar occurrences involving conduit and live wires:

- Operating Experience Summary 2000-7 reported that on March 3, 2000, at Los Alamos National Laboratory, an electrician discovered an electrical conduit and wiring were severed at the Pulsed High-Energy Radiographic Machine Emitting X-rays (PHERMEX). The 120-volt energized circuit was cut prior to February 11, 2000, during a core-drilling operation to install a pipe for a fire protection system upgrade. The circuit breaker did not trip. There was no impact to the health or safety of personnel or the environment. Nevertheless, an undiscovered hot wire presented a potential ground fault condition and a shock hazard to workers. (ORPS Report ALO-LA-LANL-FIRNGHELAB-2000-0003) A second event occurred on March 27, 2000, at the Pantex Plant, when a contractor employee was moving a conduit while cleaning a foundation trench. The conduit separated at a tee conduit fitting, nicking the insulation. This caused a direct electrical contact with the side wall of the conduit and a resultant electrical arc. There were no injuries to personnel, or damage to equipment or facilities as a result of this incident. (ORPS Report ALO-AO-MHC-PANTEX-2000-0028)
- Operating Experience Summary 99-35 reported that on August 23, 1999, at the Pantex Plant, a construction manager learned that a contractor had cut into a conduit containing a 480-volt electrical cable with a band saw. The contractor was supposed to remove a conduit for a public address system that contained low-voltage wiring but accidentally started to cut into the wrong conduit. A supervisor saw the contractor cutting the conduit, realized the mistake, and stopped him before the saw contacted the energized cable. The 480-volt cable provides power to an air-handling unit in a building bay. The air-handling unit was not operating at the time of the incident. The contractor was fortunate that he was stopped in time to prevent an electrical shock or injury. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0060)
- Operating Experience Summary 98-43 reported that on October 19, 1998, at the Idaho National Engineering and Environmental Laboratory Test Reactor Area, a construction subcontractor severed an energized 220-V, 20-amp evacuation siren electrical circuit while drilling through a composite steel/masonry block wall. Facility personnel tagged the siren out of service. Investigators determined that the conduit was concealed between the exterior steel siding and the building masonry block. The facility manager directed construction personnel to stop all project construction work until further investigation and corrective actions were completed. (ORPS Report ID--LITC-TRA-1998-0019)

These events underscore the importance of using effective work control practices and detailed pre-job planning for demolition and construction activities. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analysis must be included in the work control process to help prevent worker injury and should include provisions for drawing reviews, job-specific walk-downs, personnel protective equipment, and the use of equipment to detect embedded conduit. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with penetration activities.

DOE facility managers should ensure that personnel understand the basics of work control practices and work planning. The following are some documents that provide guidance for performing work where the potential of concealed utilities exists.

Lessons Learned Report, Issue 98-02**,** *Penetrating Hidden Utilities* is available at http://www.tis.eh.doe.gov/web/oeaf/lessons_learned/reports/.

29 CFR 1926.416(a)(3), *Protection of Employees,* can be found in OSHA regulations available at http://www.osha-slc.gov/OshStd_data.

DOE/EH-0557, Safety Notice 98-01, *Electrical Safety*. Safety Notices are available at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: Damaged conduit, construction safety, electrical safety, work control

FUNCTIONAL AREAS: Construction Safety, Worker Safety, Electrical Engineering

7. REPEATED SUBCONTRACTOR FALL PROTECTION SAFETY VIOLATIONS

On April 1, 2000, at Savannah River, Solid Waste Management Facility (SWMF) management suspended all subcontractor construction activities after observing subcontractor personnel violating fall protection safety requirements. These occurrences involved three different subcontractor companies. The series of related occurrences was collectively considered significant although there were no worker injuries or damage to equipment. Disregard of fall protection safety procedures can lead to serious worker injury.
(ORPS Report SR--WSRC-SLDHZD-2000-0002)

Investigators determined that DOE facility representatives observed several violations related to fall protection during the week of March 27, 2000, and facility management thought the activities so egregious that they suspended all subcontractor construction work until further investigation. The safety violations are as follows:

- An employee was observed on March 28 not using fall protection while working on a scissors lift. The worker was wearing a safety harness, but was not attached to the scissors lift.
- On March 30 an electrician was observed descending a twelve-foot ladder using one hand while carrying four six-foot sections of conduit with his other hand.
- On March 31 construction personnel were observed on a roof wearing safety harnesses but not connected to the installed lifeline cable. Another employee was observed sitting on the edge of the roof without fall protection. Another construction employee was observed operating a scissors lift without fall protection.
- On April 1, a sheet metal worker was observed leaning over the edge of the twelve-foot high secondary containment enclosure drilling holes in an exhaust duct flange. One construction employee was in a scissors lift wearing a safety harness that was not tied off, and another employee was not wearing a required hard hat.

Investigators believe construction employees do not understand and/or embrace fall protection rules, as shown by the numerous separate incidents of improper fall protection practice or improper use of personal protective equipment. All the equipment necessary for safe work (including safety harnesses, scissors lifts, hard hats, ladders and various types of personal protective equipment), required in the work plans, was available but not used appropriately.

A documented standown was held on April 4, 2000, to address the following topics in depth:

- Proper use of personal protective equipment (including hard hats, safety glasses, hand and foot protection and hearing protection.
- Fall protection requirements and proper use of a safety harness (correctly wearing the harness, correct tie-off points, etc.).
- Proper use of ladders (tie-off criteria, correct extension and placement, stepladder safety, transportation of ladders, etc.).
- Proper use of manlifts (capacity, proper movement, tie-off, etc.).

Investigators found that SWMF management had not verified in writing that the subcontractors had provided appropriate worker fall protection training. SWMF management assumed everyone was properly trained based upon the familiarity from working with the same subcontractors on several previous jobs. The action plan that resulted from the stand down stipulated that the subcontractors would certify completion of fall protection training in writing as part of the work plan.
Safety citations were issued to employees for specific violations and a dedicated safety observer was appointed for the remainder of the construction project. The safety observer is empowered to take immediate action to correct

observed unsafe conditions or acts. The dedicated safety observer will inform the employee of any safety violation and instruct the employee in appropriate corrective actions. The safety observer will report daily on project status. Daily pre-job and toolbox safety meetings will be conducted before work begins each morning.

EH Engineers have reported similar occurrences involving fall protection safety violations:

- Operating Experience Summary 2000-06 reported that on March 10, 2000, at the West Valley Demonstration Project, safety and health personnel observed a subcontractor employee on a roof without fall protection. The worker was signaled by the safety engineer to step away from the roof edge. The edge of the roof was approximately 15 feet above a lower level roof. Prompt action by the safety engineer corrected a serious fall hazard condition. (ORPS Report OH-WV-WVNS-WVNSGEN-2000-0001
- Operating Experience Summary 2000-01 reported that on December 21, 1999, at the Savannah River Site, a Separations Mechanic fell while descending a nine-foot scaffold. Site Emergency Medical Services personnel responded by providing first aid, and transported the mechanic to the Aiken Regional Medical Center Hospital. The mechanic suffered a fractured right ankle, which required surgery to insert a plate and eight screws. The scaffolding carried an incomplete assembly tag because obstructions prevented the installation of a grab rail or a ladder that extended above the working platform. (ORPS Report SR--WSRC-SEPGEN-1999-0004)
- Operating Experience Summary 99-24 reported that on June 10, 1999, at the Brookhaven National Laboratory, a contractor worker fell approximately 10 ft from the top of a storage tank, sustaining bruises and abrasions on his face, an arm, and a knee. Emergency medical team personnel transported him to a local hospital for treatment and observation. He was released the same day. The worker was on top of the tank to receive a hose from another worker on the ground when he fell. Fall protection was provided on top of the tank in the form of a platform and railings, but the worker went outside the fall protection area to retrieve the hose. (ORPS Report CH-BH-BNL-BNL-1999-0015)

KEYWORDS: fall protection, ladder, safety harness, scissors lift, hard hat

FUNCTIONAL AREAS: Construction Safety, Worker Safety

8. LIFTING MECHANISM FAILURE

On March 21, 2000, at Sandia National Laboratory, a lifting mechanism failed while operators were hoisting an 800-pound diagnostic assembly. The operators immediately lowered the assembly to the floor and checked the assembly for damage. They were in the process of moving the diagnostic assembly and had raised it approximately two inches off the floor when one of the three lifting eyebolts pulled out of the top of the assembly. There were no injuries or equipment damage. An improper design can result in dropped loads, equipment damage and personnel injury. (ORPS Report ALO-KO-SNL-1000-2000-0004)

The diagnostic assembly (Figure 8-1) is a lead-shielded experimental chamber containing a crystal spectrometer. The top plate of the lead assembly (Figure 8-2) is two inches thick with three $^{3}/_{8}$-inch diameter threaded holes that are 0.54 inch in depth. Each hole has a lifting eyebolt screwed into a threaded key insert (Figure 8-2). The investigators determined that one of the eyebolts had pulled from its hole and found that the other two eyebolts came out with ease.

Figure 8-1. Crystal Spectrograph Soft X-ray Diagnostic Assembly

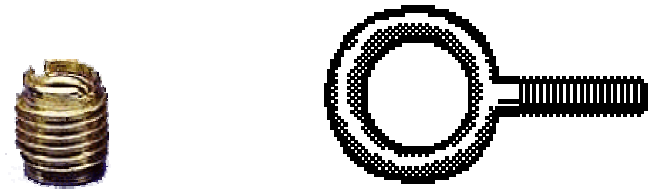

Figure 8-2. 3/8" Threaded Key Insert and Lifting Eye Bolt

Investigators discovered improper design was the likely root cause. Lead is a soft metal that is susceptible to fatigue failures in lifting operations. The investigation continues and the Operating Experience Summary will report on future findings.

EH engineers identified similar occurrences involving design failures during hoisting and rigging operations:

- Operating Experience Summary 99-37 reported that on September 7, 1999, at the Argonne National Laboratory-West, operators discovered a deformed slide-on accessory hook whose hook throat opened up to about 45 degrees. The operators were preparing to perform a small lift using the accessory hook, which fits over the auxiliary hook of a 5-ton overhead crane located in the Hot Fuel Examination Facility Hot Repair Area (HRA). Upon discovering the deformity, they stopped work and notified the facility manager. Some time before the deformed hook was discovered, two other operators had accidentally used the 500-lb-rated hook in an attempt to move a 9,000-lb shielded cask. They had inspected the hook before the lift but did not check its rating. They also did not know the weight of the load. The accessory hook is designed to slip over the larger hook of the HRA auxiliary crane to allow for the attachment of smaller rigging to the auxiliary hook. (ORPS Report CH-AA-ANLW-HFEF-1999-0006)
- Operating Experience Summary 99-23 reported that at the Idaho National Engineering and Environmental Laboratory Test Area North, a lifting eyebolt separated from a shipping container lid as operators attempted to remove the lid, which was not completely disengaged from the container. They were using a 10-ton overhead crane and sling to remove what they thought was an 850-lb lid. However, what they were really attempting to lift was the combined weight of the container, its contents, and the lid, approximately 55,000 lb. Although all personnel were well clear of the area of the container when the eyebolt failed, this occurrence was significant because of its potential for personnel injury and equipment damage. In addition, the facility incurred the cost of process delays and damage assessments for the crane and the shipping container. (ORPS Report ID--LITC-TAN-1999-0006)

DOE-STD-1090-99, *Hoisting and Rigging,* provides guidance for hoisting and rigging and identifies related codes, standards, and regulations.

KEYWORDS: hoisting and rigging, industrial safety, lifting device, improper design

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety